Effect of salicylic acid and potassium humate on the growth and yield two hybrids of cabbage (*Brassica Oleracea* L.Capitate) in southern of Iraq

Bushra Abdel Hussein Maleh Abbas Abdel Kadhim Obaid
College of Agriculture , Basrah university

Abstract

The experiment was conducted during the winter agricultural season 2020-2021 at the Agricultural Research Station of the College of Agriculture - University of Basrah. In order to study the effect of spraying with three concentrations of salicylic acid (0, 50 and 100) mg L^{-1} and three concentrations of potassium humate (0, 2.5 and 5 gm L^{-1}) on the growth and yield of two hybrids of cabbage (Galaxy and Durra).It was conducted as a factorial experiment in the system of two split plots (System Split - Split Plot) and within the design of completely randomized plots (R.C.B.D) and with three replicates, and the arithmetic means were compared using the least significant difference (L.S.D) test at a probability level of 0.05. The most important results that were obtained can be summarized as follows: The excelled of the hybrid "Durra" in the marketing head weight (1.58) kg and the marketing yield (46.59) tons ha^{-1}. The percentage of sodium in the leaves was (1.427)%, while the hybrid "Galaxy" excelled on the percentage of vitamin C In leaves (38.49 mg) 100 g fresh weight and chlorophyll in leaves (43.32) mg.The marketing yield (46.99) ton ha^{-1} The percentage of carbohydrates and the percentage of sodium in the leaves in the leaves, while the concentration of 2.5 gm L^{-1} of potassium humate excelled in vitamin C, As for salicylic acid, the concentration of 100 mg L^{-1} significantly excelled in the total number of leaves, leaf area, marketing yield (47.26) tons ha^{-1}, market head weight (1.61) kg, vitamin C, total chlorophyll, carbohydrates, sodium percentage . in papers

Keywords: Cabbage, Salsalic acid, Potassium humat, Hybrid

Introduction

The cabbage (Brassica oleracea capitata L.) is a winter vegetable belonging to the cruciferous family Brassicaceae and its original home is the eastern Mediterranean (Decoteau 2000). It is of high nutritional value because it contains water, protein, fats, carbohydrates, fibers, sugars, Ca, Fe, Mg, P, in addition to vitamins A and C (2019, (USDA), It is also a good source of vitamin K, which helps in the production of blood clotting proteins and regulates blood pressure and can reduce the risk of stroke (1983, Tumuhairwe et al; Masarirambi et al, 2013).It is rich in glutamine and amino acids necessary for intestinal health. Anonymous, 2008)) The cabbage is cultivated in most regions of Iraq, and the cultivated area in 2018 reached 3315 dunums, with a total production of 6130 tons (Directorate of Agricultural Statistics, 2018).It is known that the soil and water of southern Iraq are characterized by alkaline qualities and a high content of salinity in addition to the nature of the hot and dry climatic conditions. Such conditions lead to a decrease and loss of many nutrients by stabilizing them or their deposition or reducing their readiness, which negatively affects the plant's obtaining its need of elements and its reflection in the quantity and quality of the yield due to the occurrence of plasma stress, which is one of the main abiotic stress factors that affect every aspect of physiology, which in turn affects productivity (Gupta et al. al, 2014).Therefore, studies have tended to find ways to reduce the impact of these conditions by using some factors that can reduce their negative impact. One of these factors is salicylic acid, which is one of the natural plant hormones that has a phenolic nature and that has a positive role against biotic and abiotic stress (Kumar et al. 2016),It regulates many physiological

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processes including regulation of ion uptake, hormonal balance and stomata movement. It also has physiological roles in the synthesis of ethylene and an opposite effect of the growth inhibitor abscisic acid. In addition, salicylic acid plays an important role in regulating the response of plants to environmental stress conditions. Also, potassium humate is one of the humic acids known to have many beneficial agricultural properties such as improving soil structure, changing its physical properties, increasing the efficiency of photosynthesis and respiration of plant roots, which helps in increasing plant growth (Chen and Avaid, 1990). In a study conducted by Al-Jarrah (2020) for two agricultural seasons by cultivating three genotypes of cabbage (Pruktor F1, Luna and Rainball F1) in salt stress conditions of irrigation water in Basra Governorate, where it was observed that the hybrid Pruktor F1 was excelled in obtaining a significant increase in all carbohydrates (41.06). , 39.44) mg. 100gm-1,chlorophyll (43.86,40.63)mg. 100 g^{-1}compared to the Rainball F1 hybrid, which gave the lowest values for the experimental traits. Dabbagh (2020), in the study of adding humic acid to the plant Alhana at concentrations of 2 and 4 gm L^{-1}, the results showed that the concentration of 2 gm $L^{-1}$was excelled to the relative chlorophyll content (63.36) SPAD. (2018) Ramadan and Shalaby were found when experimenting with treating Kalorama F1 hybrid for two growing seasons (2015-2016 and 2016-2017) with salicylic acid (0, 75 and 150) mg l-1 in addition to mannitol and grown under salt stress conditions of soil and water in Egypt,The results showed that the concentration of 75 mg L^{-1} was significantly excelled on the other two concentrations in all the chemical and qualitative indicators of cabbage plant and for both seasons represented by vitamin C (34.80, 29.02) mg. mg.100gm^{-1} fresh weight, for both seasons . This research was conducted to evaluate the effect of foliar treatment with salicylic acid and the addition of potassium humate to the soil on some vegetative, yield and chemical traits of two hybrids of cabbage plant under the conditions of the southern region in Iraq.

Materials and methods

The experiment was conducted in season 2021-2020 at the Agricultural Research Station of the College of Agriculture - University of Basrah. . cabbage seeds were sown in cork dishes on 5/9/2020, the soil of the field was prepared and then divided into lines, and when the seedlings reached the stage of forming 4 real leaves, the transplanting process took place on 10/21/2020.

It was coundected as a factorial experiment according to the (Splite-Splite Plote Design) system with a randomized complete block design (R.C.B.D). Whereas Durra and Galaxy hybrids were considered in the main plot (Main plot) and potassium humate irrigated (0, 2.5 and 5 g L^{-1}) in secondary plots (Sup plot) and spraying with salicylic acid (0, 50 and 100) mg L^{-1} sub-secondary plot (Sup-Sup plot), so the number of treatments was 18 factorial treatments with three replications to include the experiment 54 experimental units. The following measurements were taken for five plants from each experimental unit, which are: Total number of leaves (leaf. $plant^{-1}$), Leaf area (dm^2), average head weight (kg), marketable yield (ton ha^{-1}), total chlorophyll (mg 100 gm^{-1} fresh weight), total soluble carbohydrate content of leaves (mg 100g^{-1} dry matter) ,The leaves content of vitamin C (mg 100gm-1 fresh weight) and the percentage of sodium in the leaves (%). The Least Significant Differences Test (L.S.D) was used to compare the means at the probability level of 0.05 (Al-Rawi and Khalaf Allah, 1980).

Results and discussion

Table (1) that there was no significant effect of the hybrid on the total number of leaves, given the concentration of 5 g L^{-1} potassium humate, the most total number of leaves reached 56.43 leaf.$plant^{-1}$, followed by the

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concentration 2.5 gm L^{-1}, which amounted to 55.89 leaf.plant^{-1} compared to the control treatment 53.29 leaf.plant^{-1}, the concentrations of salicylic acid 50 and 100 mg L^{-1} were significantly higher in this trait, reaching 55.63 and 55.79 Leaf-1, respectively. Compared to the control treatment that gave the least 54.19 leaf.plant^{-1}. It is clear from the same table that the two interactions between the hybrid "Galaxy" hybrids and the concentration of 100 mg L^{-1} salicylic acid gave the highest number of 55.90 leaves-1 compared to the lowest number of 53.59 leaf.plant^{-1}produced in the hybrid plants "Durra" that were not treated with salicylic acid.The treated plants gave 2.5 gm L^{-1} potassium humate and 50 mgL^{-1} salicylic acid, the most number of leaves was 56.63 compared to the lowest number was 50.46 leaves produced in the control treatment (without salicylic acid and potassium humate).It appears from the same table that the triple interaction between the experimental factors had no significant effect on this trait. This may be due to the variation of the genetic structure of these hybrids and their response to environmental factors, as many traits may be inherited under genetic control (Adetula, 2006), and these results are in line with the findings of both Olaniyi and Ojetayo and (2011). : Hussain et al,.2012) on the plant of cabbageThe increase, when treated with potassium humate, is due to the positive effect of the nutrients present in humic acid on plant growth by increasing the permeability of cell membranes, stimulating enzymatic reactions, cell division, cell elongation, increasing the production of plant enzymes and stimulating intracellular vitamins (Pettit, 2003)or this increase may be due to the continuous and balanced supply of nutrients by potassium humate, which led to an improvement in plant growth represented in the number of leaves and leaf area of the plant Allen and Pilbeam (2014)The reason for the increase in the number of leaves of plants sprayed with salicylic acid may be due to its role as a plant hormone in stimulating the enzymes responsible for the photosynthesis process and then accelerating the photosynthesis process. Hayat et al, (2007).Which led to an increase in the accumulation of processed nutrients in the plant or its role in increasing the level of IAA, which is one of the main factors in increasing cell division of meristematic cells in a large and rapid methods, contributing to an increase in the activity of the cell division process, in addition to the role of IAA in helping to supply cells with proteins and acids Nuclear RNA Coartney et al,.(1967)

Table (1): Effect of potassium humate and salicylic acid on the total number of leaves (leaf.plant^{-1}) Hybrids of cabbage

interaction of hybrid * potassium humate	Salicylic acid (mg L-1)			potassium humate (g.L-1)	hybrid
	100	50	0		
53.18	55.44	53.94	50.15	0	Galaxy
55.89	56.10	56.09	55.47	2.5	
56.16	56.10	57.16	55.15	5	
53.41	54.87	54.60	50.77	0	Durra
55.89	55.25	55.88	56.54	2.5	
56.70	56.94	56.10	57.05	5	
average hybrid					
55.07	55.90	55.73	53.59	Galaxy	interaction hybrid * salicylic
55.33	55.68	55.53	54.79	Durra	
potassium humate					
53.29	55.15	54.27	50.46	0	Interaction of humate* salicylic
55.89	55.67	55.90	56.00	2.5	
56.43	53.17	54.37	56.10	5	
	56.55	56.63	54.19	Average salicylic acid	

L.S.D 0.05						
hybrid , humate and Salicylic	Humates and Salicylic	hybrid and Salicylic	hybrid and Humates	Salicylic	potassium humate	hybrid
N.S	1.24	0.74	N.S	0.63	0.81	N.S

Table (2) that there was no significant effect of hybridization on the leaf area of the plant, where for potassium humate, the concentration of 5 g L^{-1} gave the most area, which amounted to 57.93 dm ^{2} , followed by the concentration of 2.5 g L^{-1}, which amounted to 56.88 dm ^{2} compared to the control treatment, which was 49.56 dm ^{2} .It was noticed that the concentrations of salicylic acid 50 and 100 mg L^{-1} were significantly higher in this trait, which reached 54.59 and 58.87 dm ^{2}, respectively, compared to the control treatment that gave the lowest leaf area was 50.91 dm ^{2} .The same table shows that there was no significant effect of the two-hybrid interaction between potassium humate and salicylic acid. While the plants treated with 5 g L^{-1} potassium humate and 100 mg L^{-1} salicylic acid gave the highest leaf area of 62.28 dm ^{2} compared to the lowest leaf area of 37.13 dm ^{2} produced in the control treatment for both factors and it appears from the same table that the plants of the hybrid "Galaxy"" were excelled to the irrigated plants with a concentration of 2.5 mg L^{-1} potassium humate and the treatment with 100 mg L^{-1} salicylic acid, which gave the highest leaf area amounted to 67.87 dm2 compared to the lowest area was 36.60 dm2 produced in the plants of the hybrid "Galaxy" and treatment Comparison of potassium humate and salicylic acid.

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Table (2) Effect of potassium humate and salicylic acid on the leaf area (dm^2) of two hybrids of cabbage

interaction of hybrid * potassium humate	Salicylic acid (mg L-1)			potassium humate (g.L-1)	hybrid
	100	50	0		
48.00	56.68	50.72	36.60	0	Galaxy
59.00	62.08	53.26	61.68	2.5	
61.48	58.76	65.25	60.43	5	
51.12	67.87	47.84	37.65	0	Durra
54.75	58.97	54.56	50.74	2.5	
54.38	48.85	55.94	58.36	5	
average hybrid					
56.16	59.17	56.41	52.90	Galaxy	interaction hybrid * salicylic
53.42	58.56	52.78	48.91	Durra	
potassium humate					
49.56	62.28	49.28	37.13	0	Interaction of humate* salicylic
56.88	60.52	53.91	56.21	2.5	
57.93	53.80	60.59	59.39	5	
	58.87	54.59	50.91	Average salicylic acid	

L.S.D 0.05						
hybrid , humate and Salicylic	Humates and Salicylic	hybrid and Salicylic	hybrid and Humates	Salicylic	potassium humate	hybrid
8.96	6.82	N.S	N.S	3.26	5.54	N.S

Potassium humate may have a role in stimulating the uptake of soil nutrients (Arancon et al., 2006). This, in turn, led to an increase in plant growth. The increase in the number of leaves and leaf area, and this helped in absorbing the other necessary elements because this nutrient contains important nutrients, which led to an increase in the green surface exposed to sunlight, and then increased the output of photosynthesis and its reflection on plant growth. This is consistent with what was found by Selim et al. (2009) on the potato plant, Selim and Mosa (2012) on the broccoli plant and Shafeek et al. (2013) on the broad bean plant. It agreed with what was found by Jasso et al, (2005) and Khalil (2016),

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which led to an increase in the leaf area. The reason for the increase in the total number of leaves and leaf area may be due to the role of salicylic acid in increasing the size and expansion of plant cells through its role in increasing the elasticity and ductility of cell walls and increasing their expansion (Adams et al., 1975) or it may have a role in increasing the absorption of water and nutrients, thus increasing the efficiency of photosynthesis, which helps in increasing its protoplasmic content, which is reflected on the surface area, size and tissues of the plant (Byers et al., 1990), which makes it an aid to the division process, which was reflected in the increase in the number of leaves. This result is consistent with what was obtained by Yildirim et al. (2008) in the cucumber plant .It is noted from Table (3) that the hybrid "Durra" significantly excelled in obtaining the highest marketable head weight of 1.59 kg compared to the lowest weight of the hybrid "Galaxy" which reached 1.51 kg. It was also noted that the concentration of 5 mg L^{-1} potassium humate was significantly excelled 1.60 kg, followed by The concentration of 2.5 g L^{-1} was 1.59 kg compared to the control treatment, which gave the lowest weight was 1.45 kg,As for salicylic acid, the concentration of 100 mg L^{-1} was 1.61 kg, followed by the concentration 50 mg L^{-1}, which amounted to 1.57 kg, respectively, compared to the control treatment, which gave the lowest weight of 1.45 kg.

Table (3) Effect of potassium humate and salicylic acid on marketing head weight (kg) Hybrids of cabbage

interaction of hybrid * potassium humate	**Salicylic acid (mg L-1)**			**potassium humate (g.L-1)**	hybrid
	100	50	0		
1.41	1.51	1.47	1.24	0	Galaxy
1.51	1.52	1.48	1.54	2.5	
1.60	1.61	1.63	1.54	5	
1.49	1.71	1.49	1.27	0	Durra
1.67	1.72	1.69	1.61	2.5	
1.60	1.58	1.71	1.52	5	
average hybrid					
1.51	1.55	1.53	1.44	Galaxy	**interaction hybrid * salicylic**
1.59	1.67	1.63	1.46	Durra	
potassium humate					
1.45	1.61	1.48	1.25	0	**Interaction of humate* salicylic**
1.59	1.62	1.59	1.58	2.5	
1.60	1.61	1.67	1.53	5	

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	1.61	1.58	1.45	Average salicylic acid		
L.S.D 0.05						
hybrid , humate and Salicylic	**Humates and Salicylic**	**hybrid and Salicylic**	**hybrid and Humates**	**Salicylic**	**potassium humate**	**hybrid**
0.12	0.08	0.09	0.07	0.05	0.05	0.07

It is clear from the same table that the bi-interactions between the experimental factors had a significant effect on this trait, where the hybrid "Durra" plants treated with a concentration of 2.5 g L^{-1} potassium humate gave the highest market weight of 1.67 kg compared to the lowest weight was 1.41 kg produced in the hybrid "Galaxy" plants. which were not treated with potassium humate, Hybrid "Durra" plants treated with a concentration of 100 mg L^{-1} salicylic acid significantly gave the highest Marketing Weight of 1.67 kg compared to the lowest weight was 1.44 kg produced in plants of the hybrid "Galaxy" that were not treated with salicylic acid.The excelled of plants treated with a concentration of 5 g L^{-1} potassium humate and 50 g L^{-1} salicylic acid was observed, which amounted to 1.67 kg compared to the lowest weight was 1.25 kg resulting in the control treatment for each of potassium humate and salicylic acid.It appears from the same table that the triple interaction between the experimental factors had a significant effect on this trait, where the plants of the hybrid "Durra" treated with a concentration of 5 g L^{-1} potassium humate and 100 mg L^{-1} salicylic acid gave a significant effect. Where it gave the highest Marketing Weight of 1.72 kg compared to the lowest weight was 1.24 kg produced in "Galaxy" hybrid plants that were not treated with both compounds. It is noted from Table (4) that the hybrid "Durra" was significantly excelled in obtaining the highest market yield for heads of 46.59 tons per hectare, and control plants "Galaxy hybrid" 44.18 tons .ha $^{-1}$.As for potassium humate, the concentrations 2.5 and 5 g L^{-1} gave the highest market yield of 46.72 and 46.99 tons ha^{-1}, respectively, compared to the control treatment 42.45 tons ha^{-1},The results showed that the concentrations of salicylic acid 50 and 100 mg L^{-1} were significantly higher in this trait and they reached 46.28 and 47.26 tons ha^{-1}, respectively, compared to the control treatment that gave the lowest yield of 42.61 tons ha^{-1}.It is noted that the hybrid "Durra" plants treated with a concentration of 2.5 g L^{-1} potassium humate had the highest market yield of 49.06 tons ha^{-1} compared to the lowest yield was 41.24 tons ha^{-1} produced in the hybrid "Galaxy" plants that were not treated with humate. potassium, As for the bi-interaction between hybrids and salicylic acid, it did not have a significant effect on this trait, while plants treated with a concentration of 5 g L^{-1} potassium humate and 50 mg L^{-1} salicylic acid gave the highest market yield of heads amounting to 48.93 tons ha^{-1} In control treatment, the lowest market yield of heads was 36.75 tons ha-1 produced in the control treatment of each of potassium humate and salicylic acid. It appears that plants of the hybrid "Durra" treated with a concentration of 5 gm l-1 potassium humate and 100 mg l-1 salicylic acid gave the highest market yield of heads. It was 50.35 tons ha^{-1} compared to the lowest yield was 36.38 tons ha^{-1} produced in "Galaxy" hybrid plants that were not treated with both compounds.The obtained results indicated that the hybrid “Durra” plants were significantly excelled in the marketable head weight and the marketable yield over the “Galaxy” hybrid plants. The difference between the hybrids may be due to genetic control, the prevailing climatic conditions and their suitability for plant growth Or that the reason for the excelled of the hybrid “Durra” in these two traits is due to the fact that the prevailing environmental conditions were more favourable than the other hybrid and this

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result is consistent with what was found by Al-Maliki (2013) Al-Shammari et al. (2019) and Al-Jarrah (2020) on the plant of Cabbage.

Table (4) Effect of potassium humate and salicylic acid on the marketing yield (ton ha^{-1}) Hybrids of cabbage

interaction of hybrid * potassium humate	Salicylic acid (mg L-1)			potassium humate (g.L-1)	hybrid
	100	50	0		
41.24	44.20	43.14	36.35	0	Galaxy
44.38	43.35	43.26	45.26	2.5	
46.93	47.87	47.75	45.17	5	
43.65	50.14	43.70	37.12	0	Durra
49.06	50.35	49.66	47.18	2.5	
47.04	46.45	50.10	44.57	5	
average hybrid					
44.18	45.53	44.75	42.27	Galaxy	interaction hybrid * salicylic
46.59	48.98	47.82	42.95	Durra	
potassium humate					
42.45	48.17	43.42	36.75	0	Interaction of humate* salicylic
46.72	47.44	46.51	46.22	2.5	
46.99	47.16	48.93	44.87	5	
	47.26	46.28	42.61	Average salicylic acid	
L.S.D 0.05					

hybrid , humate and Salicylic	Humates and Salicylic	hybrid and Salicylic	hybrid and Humates	Salicylic	potassium humate	hybrid
3.56	2.56	N.S	2.17	1.50	1.67	2.15

It is noticed from table (5) that the hybrid "Galaxy" was significantly excelled in obtaining the highest chlorophyll content in the leaves, which amounted to 43.32 mg 100 gm^{-1} fresh weight compared to the lowest content of 41.41 mg 100 g^{-1} for hybrid "Durra" plants.As for potassium humate, the concentration of 5 g L^{-1} gave the highest content of chlorophyll in the leaves of chlorophyll was 45.44 mg 100 g^{-1}, followed by

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the concentration 2.5 g L^{-1} it amounted to 43.65 mg 100 g^{-1}.Compared to the control treatment was 39.50 mg 100 g^{-1}, it was noticed that the concentration of 100 mg L^{-1} of salicylic acid was excelled, followed by the concentration of 50 mg L^{-1} significantly in this trait, which amounted to 44.44, 43.21 mg. 100 significant effect on this trait, while the "Galaxy" hybrid plants treated with a concentration of 100 mg L^{-1} amounted to 44.96 mg 100 g^{-1} compared to the lowest content of 40.65 mg 100 gm^{-1} which was produced in plants of 100 mg L^{-1}. the same hybrid that was not treated with salicylic acid,The plants treated with a concentration of 5 gm L^{-1} potassium humate and 100 mg L^{-1} salicylic acid gave the highest chlorophyll content of 46.13 mg 100 gm^{-1} compared to the lowest value was 35.37 mg 100 gm^{-1} produced in the comparison treatment for each of g^{-1}, respectively, compared to the control treatment that gave the lowest content of chlorophyll was 40.94 mg. 100 g^{-1}. It was found that the binary interaction between the two hybrids of Cabbage and potassium humate had no

potassium humate and salicylic acid. It appears from the same table that the triple interaction between the experimental factors had a significant effect on this trait, where the hybrid "Galaxy" plants excelled on the irrigated plants at a concentration of 2.5 gm L^{-1} potassium humate and 50 mg L^{-1} salicylic acid.Where it gave the highest chlorophyll content of 46.43 mg 100 g^{-1} compared to the lowest value was 33.14 mg 100 g^{-1} produced in the same hybrid plants and the control treatment of potassium humate and salicylic acid.

Table (5) Effect of potassium humate and salicylic acid on total chlorophyll content of leaves (mg 100 g^{-1} fresh weight) for two hybrids of cabbage

interaction of hybrid * potassium humate	**Salicylic acid (mg L-1)**			**potassium humate (g.L-1)**	hybrid
	100	50	0		
40.65	44.64	42.04	33.14	0	Galaxy
44.64	44.12	46.43	43.37	2.5	
45.37	46.12	44.54	45.44	5	
39.94	41.17	38.41	37.60	0	Durra
42.66	44.47	42.20	41.30	2.5	
45.52	46.13	45.64	44.77	5	
average hybrid					
43.32	45.37	44.34	40.65	Galaxy	interaction hybrid * salicylic
42.41	45.52	42.66	39.06	Durra	
potassium humate					
39.50	42.91	40.23	35.37	0	Interaction

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43.65	44.30	44.32	42.33	2.5		of humate* salicylic
45.44	46.13	45.09	45.11	5		
	44.44	43.21	40.94	Average salicylic acid		
L.S.D 0.05						
hybrid , humate and Salicylic	**Humates and Salicylic**	**hybrid and Salicylic**	**hybrid and Humates**	**Salicylic**	**potassium humate**	**hybrid**
2.05	1.58	0.96	N.S	0.81	1.22	9.43

Table (6) that there was no significant effect of hybrids on the total carbohydrate content of leaves. As for potassium humate, the concentrations of 2.5 and 5 g L^{-1} gave the highest carbohydrate content of 38.17 and 38.71 mg .g^{-1}, respectively. Compared to the control treatment was 26.76 mg g^{-1}, it is noticeable that the concentrations of salicylic acid 50 and 100 mg L^{-1} were significantly excelled in this trait as they reached 36.24 and 36.18 mg g^{-1}, respectively, Compared to the control treatment that gave the lowest carbohydrate content was 31.23 mg g^{-1}. It is clear from the same table that the bi-interaction between the experimental factors of hybrids and potassium humate has a significant effect on this trait. The hybrid Durra plants treated with a concentration of 2.5 g L^{-1} potassium humate excelled 40.39 mg g^{-1} compared to the lowest amount of 23.75 mg g-1 produced in the plants of the hybrid "Galaxy" that were not treated.While the hybrid Durra plants treated with a concentration of 50 mg L^{-1} salicylic acid were excelled to 38.31 mg g^{-1} compared to the lowest amount was 31.10 mg g^{-1} produced in plants of the hybrid "Galaxy" that were not treated with salicylic acid.The plants treated with a concentration of 5 g L^{-1} potassium humate and 100 mg L^{-1} salicylic acid had the highest carbohydrate content in leaves of 40.47 mg g-1 compared to the lowest content of 20.72 mg g^{-1} produced in plants that were not treated with both compounds. It appears from the same table that the triple interaction between the experimental factors did not have a significant effect on this trait.

Table (6) Effect of potassium humate and salicylic acid on the total carbohydrate content of leaves (mg L^{-1}) of two hybrids of Cabbage

interaction of hybrid * potassium humate	**Salicylic acid (mg L-1)**			**potassium humate (g.L-1)**	hybrid
	100	50	0		
23.75	26.37	25.07	19.82	0	Galaxy
35.96	34.85	36.66	36.36	2.5	
39.67	41.11	40.76	37.13	5	
29.77	33.29	34.40	21.62	0	

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40.39	41.64	41.26	38.26	2.5	Durra
37.76	39.83	39.27	34.17	5	
average hybrid					
33.13	34.11	34.16	31.10	Galaxy	interaction hybrid * salicylic
35.97	38.25	38.25	31.35	Durra	
potassium humate					
26.76	29.83	29.73	20.72	0	Interaction of humate* salicylic
38.17	38.24	38.96	37.31	2.5	
38.71	40.47	40.01	35.65	5	
	36.18	36.24	31.23	Average salicylic acid	

L.S.D 0.05						
hybrid , humate and Salicylic	**Humates and Salicylic**	**hybrid and Salicylic**	**hybrid and Humates**	**Salicylic**	**potassium humate**	**hybrid**
N.S	4.25	6.75	6.52	1.59	3.86	N.S

It is noted from Table (7) that the plants of the hybrid "Galaxy" were excelled, where they gave the highest value of the leaves content of vitamin C, which amounted to 38.49 mg 100 g^{-1} compared to 36.33 mg 100 g^{-1} produced in the hybrid "Durra" plants.As for potassium humate, the concentrations of 2.5 and 5 g L^{-1} reached 38.46 and 38.45 mg 100 g L^{-1} compared to the control treatment which was 35.33 mg 100 g $^{-1}$. The concentrations of salicylic acid 50 and 100 mg L^{-1} were significant in this trait. 37.48 and 38.18 mg 100g^{-1}Compared to the control treatment that gave the lowest percentage was 36.57 mg 100 g^{-1}.

It is clear from the same table that the bi-interaction between hybrids, potassium humate and salicylic acid had no significant effect on this trait. Plants treated with a concentration of 2.5 g L^{-1} potassium humate and 100 mg L^{-1} salicylic acid had the highest vitamin C content of 39.17 mg 100 gm^{-1} compared to the lowest value of 33.02 mg 100 gm^{-1} in plants that were not treated with potassium humate and salicylic acid. It appears from the same table that the triple interaction of the “Galaxy” hybrid , treated with a concentration of 2.5 g L^{-1} potassium humate and 100 mg L^{-1} salicylic acid, gave the highest significant value in vitamin C content of 41.03 mg 100 g^{-1}.The lowest value was 32.42 mg 100 g^{-1} produced in hybrid plants that were not treated with both compounds.

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Table (7) Effect of Potassium Humate and Salicylic Acid on Vitamin C Content of Leaves (mg 100gm^{-1} fresh weight) for two hybrids of cabbage

interaction of hybrid * potassium humate	Salicylic acid (mg L-1)			potassium humate (g.L-1)	hybrid
	100	50	0		
36.63	38.85	37.42	33.62	0	Galaxy
38.39	41.03	38.97	39.50	2.5	
39.01	38.50	38.79	39.74	5	
34.02	35.57	34.08	32.42	0	Durra
37.08	37.30	37.10	36.83	2.5	
37.90	37.82	38.55	37.33	5	
average hybrid					
38.49	39.46	38.39	37.62	Galaxy	interaction hybrid * salicylic
36.33	36.89	36.58	35.53	Durra	
potassium humate					
35.33	37.21	35.75	33.02	0	Interaction of humate* salicylic
38.46	39.17	38.03	38.17	2.5	
38.18	38.16	38.67	38.54	5	
	38.18	37.48	36.57	Average salicylic acid	
L.S.D 0.05					
hybrid , humate and Salicylic	Humates and Salicylic	hybrid and Salicylic	hybrid and Humates	Salicylic	potassium humate	hybrid
2.19	1.71	N.S	N.S	0.71	1.50	1.22

Table (8) that the hybrid "Durra" plants gave the lowest percentage of sodium in the leaves, which amounted to 1.427% compared to the hybrid "Galaxy" plants, which gave the highest percentage of 1.528%. As for potassium humate, the concentration of 5 mg L^{-1} showed a significant decrease in sodium 1.397%, the concentration of 2.5 g L^{-1} was significantly different, amounting to 1.429% compared to the control treatment was 1.606%. The reason for a significant decrease in the concentrations of salicylic acid 50 and 100 mg L^{-1} in obtaining the lowest percentage of sodium was 1.447% and 1.445%, respectively, compared to the control treatment was 1.540%.The plants of the hybrid "Durra" treated with a concentration of 5 g L^{-1} potassium humate gave a decrease in the percentage of sodium that amounted to 1.364% compared to the highest percentage

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that was 1.714% produced in the plants of the hybrid "Galaxy" that were not treated with potassium humate. As for the bi-interaction between hybrids and salicylic acid, there was no significant effect in this trait, while plants treated with a concentration of 5 g L^{-1} potassium humate and 100 mg L^{-1} salicylic acid gave a significant decrease in sodium percentage that amounted to 1.362% compared to the highest percentage which was 1.579% resulted in control treatment of potassium humate and salicylic acid.It appears from the same table that the triple interaction between the factors of the experiment did not have a significant effect on this trait.

Table (8) Effect of potassium humate and salicylic acid on the percentage of sodium (%) of two hybrids of cabbage

interaction of hybrid * potassium humate	**Salicylic acid (mg L-1)**			**potassium humate (g.L-1)**	hybrid	
	100	50	0			
1.714	1.623	1.690	1.828	0	Galaxy	
1.440	1.536	1.364	1.420	2.5		
1.430	1.423	1.359	1.506	5		
1.499	1.388	1.420	1.690	0	Durra	
1.418	1.413	1.423	1.417	2.5		
1.364	1.301	1.413	1.380	5		
average hybrid						
1.528	1.527	1.471	1.585	Galaxy	interaction hybrid * salicylic	
1.427	1.367	1.419	1.496	Durra		
potassium humate						
1.606	1.506	1.555	1.759	0	Interaction of humate* salicylic	
1.429	1.474	1.394	1.418	2.5		
1.397	1.362	1.386	1.443	5		
	1.447	1.445	1.540	Average salicylic acid		
L.S.D 0.05						

hybrid , humate and Salicylic	**Humates and Salicylic**	**hybrid and Salicylic**	**hybrid and Humates**	**Salicylic**	**potassium humate**	**hybrid**
N.S	0.11	N.S	0.04	0.07	0.04	0.02

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The results of the experiment indicated that the hybrid "Galaxy" was significantly excelled in total chlorophyll, total carbohydrates, sodium and vitamin C, while the hybrid "Durra" plants were significantly excelled in vitamin C. This may be due to the role of the genetic factors of the hybrid and their response to climatic factors.The results show an increase in the content of leaves from chlorophyll pigment, carbohydrates, in addition to vitamin C, and a decrease in sodium by increasing the level of fertilizing with potassium humate. To the high rate of mineralization and the readiness of nutrients, which increases its absorption in the plant (Saleh et al. 2003): Al-Mohammadi, 2009) and that the increase in the chlorophyll content of the leaves can be sue to the positive effect of potassium humate in increasing the photosynthesis process, which results in an increase in the chlorophyll content of the leaves (Ameri and Tehranifar 2003, Perhaps the nitrogen, which is prepared by adding potassium humate, speeds up the absorption and transmission of the rest of the elements by entering it into the formation of chlorophyll pigments, thus increasing the process of carbon synthesis and building proteins of great importance in stimulating plant growth and increasing its efficiency in absorbing and accumulating the rest of the elements (Taiz and Zeiger, 2006)). It also has a role in reducing soil acidity (Whaien et al., 2006), which increases the availability of nutrients. It agrees with what Al-Sawaf and Omar (2017) found on the plant of cabbage An increase in the leaves content of chlorophyll pigment, carbohydrates, in addition to vitamin C, and a decrease in the percentage of sodium when spraying the plant with salicylic acid, an increase in the content of chlorophyll in the leaves, which may be attributed to the inhibition of the enzyme chlorophylase, which works to demolish chlorophyll pigment and also helps to build Plastids through its contribution to the formation of krana sheets Singh, (2008) Singh and.Salicylic acid has a role in increasing the absorption of elements and improving the process of carbon metabolism in the plant, thus improving the opening of stomata (Khan et al, 2003)). It also helps the accumulation of elements in the leaves by regulating the roots and transpiration and the strength of pulling the rising sap when it evaporates, the level of elements in the leaves increases (1997Popova et al.,). The increase in the content of nitrogen, phosphorous and potassium in leaves is due to salicylic acid due to encouraging the absorption of nutrients from the soil and thus increases their concentration in the plant (Bora, 1970).

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